STANDARDS FOR RESEARCH [1]

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I have acquired the habit in the last year or two of collecting papers and published addresses dealing with the general aspects of research--contributions from those who have had to do with the training and selection of research workers, the approval of research programs, and the critical reading of research papers. Some of the ideas expressed in these papers, together with a few of my own, I would like to pass on to you to serve as the basis of an informal discussion of standards for research.

The Nature and Function of Research.--Instead of attempting to define research I am going to quote from a few of the papers in my collection.

> "Research is a mental process superimposed upon the observation of facts....I think we stretch much too far our sympathy with the piece of research which is just one more little pebble in the palace of knowledge. We are apt to encourage the collection of pebbles to put around the flower borders and grounds instead of hewn stone to build into new wings." (1) [2]

> "Research consists of more than the mere accumulation and publication of facts....The present tendency is to accumulate a superabundance of facts and data and devote too little time and effort in the proper correlation and interpretation of them. It is high time that we do relatively more thinking and less investigating if we are to maintain the high standards which have been set up for us by the past masters of science." (2)

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[1] Presented at a conference of Home Economics research workers at the annual meeting of the Association of Southern Agricultural Workers, Jackson, Miss., February 6, 1930.

[2] Reference is made by number to "Literature cited," p. 12.

> "Research logically and methodically proceeds from known facts to the immediately preceding or underlying facts.... No experiment station that encourages shallow digging or a gleaning process in its research to the exclusion of fearless fundamental investigations, no experiment station that demands of its staff that all of its results be expressed or understandable in the simplest terms of extension circulars is worthy of the name of a real experiment station." (3)

Running through all of these statements is the simple theme that mere fact-finding for purposes of demonstration does not constitute research, but that there must be a mental process superimposed upon the observation of facts to the end that new truths may be discovered. In the development of home economics research one of the most difficult obstacles to overcome has been the tendency to be content with fact-finding. It is true that many projects seem logically to end with the acquisition of facts. If that is the case they are not research, but service projects and the research worker is really a technician. From the early days of research under Purnell funds to the present time home economics departments have been called upon to do fact-finding for other departments. Some of the vitamin content studies and baking studies illustrate this type of project. In these days when emphasis is being placed more and more upon cooperative research a certain amount of such service is to be expected, nor is it entirely one-sided. Many home economics projects require service from other departments for their successful completion. Service projects for other departments are generally part of real research projects and if the home economist sees the research value of the project as a whole rather than the technical phases with which she herself is primarily concerned the project is rescued from the level of a mere service project through the contribution she may be able to make to the interpretation of the facts she is finding.

Not so fortunate is the case of the research worker who has been busily engaged in gathering facts without any reference to their setting and who is unable thereby to interpret these facts. Dr. Allen once illustrated this situation aptly by comparing such fact-finders with amateur collectors who gather up specimens of fossils and rocks in unusual localities without study or record of the surrounding conditions and thus rob them of all their scientific value. Some of the early failures in rural home management studies depending upon the survey method have been due to relegating the field work to incompetent fact finders. To quote Dr. Allen, "Too often the field work has been left to untrained observers, while those who are trained to see, to wonder, and to discern remain at their desks. As a result the facts recorded in connection with the survey may not be studied in their natural setting, or with reference to other facts they may suggest which might have a bearing or offer an explanation." (4)

I feel that one test of the research value of a project is whether or not it leads into another on completion. It is an encouraging sign that in several States there has been such a sequence of projects--one leading almost inevitably into another, the research advancing by gradual steps and systematically--or proceeding from known facts to the immediately preceding or underlying facts.

The Training and Qualifications of the Research Worker.--Since this is a group of research workers perhaps this topic should be omitted from the discussion, but I feel sure that from the standpoint of your research experience you are in a position to state quite emphatically what should be required in preparation for research. Dr. Goldforb, chairman of the section of Medical

Science of the American Association for the Advancement of Science, in an address at the Des Moines meeting of the Association deplored the prevailing system of teaching the various sciences in high schools, colleges, and universities by the so-called factual method. He said

> "In what courses of science is the student expected to frame his own question, find suitable material (including bibliography) and apparatus, devise his own experiment, analyze the conditions, arrange one set of conditions where all are constant or known, another where only one condition or factor is unknown, to vary this unknown, i.e., to find the immediate cause of the phenomenon? To determine not facts or laws, but the condition or conditions under which a phenomenon can be made to appear? To get the same results, to deduce proper conclusions from the experimental data, to watch for the crucial exception, so significant as a clue to further resolution of the constituent conditions, to plan the next experiment? Where is it taught that not facts or tools or materials or technic, but the method of experimental investigation is the test of scientific procedure." (5)

In his opinion it is the failure to teach science in this way which is responsible for poor quality in research as shown in manuscripts submitted for publication in scientific journals. In his words, "Maltraining like malnutrition, if long continued, has very serious and lasting effects upon the organism." It is comforting to think that not all the blame for poor quality in research is placed upon the research workers, but that part of it can be laid to antiquated methods of teaching the sciences in colleges and universities.

To poor quality in some of the science teaching in colleges I would add inadequate preparation in English, foreign languages, and subjects allied to the particular field in which research is to be conducted. To attempt to carry on a project in standards of living without a background of economics and statistical methods is an extreme illustration of this.

Passing from undergraduate to graduate training, it is naturally

assumed that a person who has acquired a Ph. D. degree is thoroughly conversant with the research method and able to formulate his own project and method of attack. Unfortunately in some institutions the desire to maintain the highest quality in research results in the policy of allowing the candidate for the degree to take part in the research of the professor under whom he is working rather than undertake an independent research problem of his own. This results, as Dr. Eaton of Cornell has pointed out, in training as a technical assistant rather than as a researcher. The highest quality in research may be attained, but at the expense of the production of a competent researcher--one who in Dr. Eaton's words is "able to locate and define a problem for investigation, able to plan and carry through a technic of inquiry appropriate to the solution of the problem; able to organize and interpret in their immediate bearings at least, the findings to which his inquiry leads." (6)

The administrative heads of home economics departments, particularly those who have been eager for funds and more funds for research, have a grave responsibility for the training of research workers to meet the needs of expansion in this field. This responsibility begins in the undergraduate curriculum, which should make it possible for the student who has research leanings to acquire the necessary undergraduate training in English, foreign languages, and fundamental sciences, including economics and sociology. In graduate work the student preparing to enter research should be given training in research methods through seminars and the undertaking under guidance of a research problem of her own. This naturally suggests the question of the part which this type of student research should play in the research

program. In Dr. Eaton's opinion the research conducted by students as part of their training should be undertaken not for "the sake of its value in contributing to the sum of known truth, but as a means to the development of competency in prospective researchers."

The Research Project.--Theoretically every home economics department which includes research in its activities should have a definite long time program of research. Whether this should be in all of the various subject matter interests comprising home economics or in only one or two will depend upon many factors, so varied in the different institutions that it is not worthwhile here to mention them, but even if the research is to be in one field only as in textiles or foods and nutrition, there should be a general plan or program into which the individual research projects fit.

Practically, however, it is more often the case that the research program is built up gradually from individual projects, sometimes, alas in a rather hit-or-miss manner. If the research begins with a single project which in its development inevitably leads to another and this in turn to another, the results may be of greater value than those coming from an inflexible program thought out entirely in advance of the research. The former method requires a certain degree of continuity, the latter of flexibility to be productive of the best results. If there is no sequence in either one there develops a tendency to jump from one thing to another--to be at the beck and call of any one who wishes to obtain new facts about this or that. In other words, the research resolves itself into miscellaneous service projects if not safeguarded by a definite policy. It is in the matter of developing a sound research program that the advice is most timely that "it

is high time that we do relatively more thinking and less investigating if we are to maintain the high standards which have been set up for us by the postmasters of science."

Assuming the ideal situation of a carefully planned program, the first step to take in initiating research is to set up a research project. This is admittedly the most satisfactory plan for conducting any research and a requirement for research conducted under Federal funds, the administration of which is definitely on a project basis. Each project is submitted as a unit with a definite estimate of funds required for conducting it. Since the nature, scope, and method of attack of the project are judged from the project statement alone, it is essential that this be made as clear and convincing as possible. From the standpoint of the research worker herself the thinking and study involved in setting down in black and white the why and how of a project can not help but clarify her ideas and establish a working basis for the project. As Dr. Allen said in his 1928 address before the subsection on Experiment Stations of the Association of Land-Grant Colleges and Universities:

> "Ability to state a problem, to analyze it into its significant features and set up a workable part is a significant attribute of the research worker. Generally speaking, the project outline is one of the clearest evidences of a worker's purpose and the operation of his mind. There are exceptions, of course, in which the work and point of view of the investigators are advancing so fast that narrow, specific limitations would require constant revision. We can all think of such cases in the advanced ranges of original inquiry, and no administrative officer would wish to handicap individuality and initiative by undue formalities. Frequent conference will enable the changing course of attack to be followed. But for the rank and file, the project statement is a means of judging of merits and readiness to undertake the task. The worker who is indefinite and insists upon too much latitude usually has not studied his subject or thought it through to the point of forming a tentative working plan." (7)

In this address valuable suggestions for project writing are given in a dis-

cussion of types of project defects, with illustrations drawn from among the many projects submitted to the Office of Experiment Stations for approval. For the comfort of home economics research workers, none of whom have had long experience in the preparation of project statements, it may be stated that Dr. Allen considerately took his illustrations of project defects from the old established fields of agricultural research and not from the newer fields of agricultural economics, home economics, and rural sociology.

For constructive suggestions as to how to proceed in preparing a project statement I can do no better than quote from the 1927 report of the Committee on Experiment Station Organization and Policy. (8)

> "Your committee recommends as a policy to research workers and responsible administrative officers more careful scrutiny of new projects, keeping in mind:
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> The Title: This should characterize the concrete, limited unit of work to be undertaken and not cover the entire field to which the project is related.
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> The Objective. It should be clear cut and specific, and not involved with statements of procedure.
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> The Outlook. The project should be constructive in character. It should take account of the status of the question, attack points which need further study, supplement other work, exhibit vision and ingenuity, and give prospect of success.
> What, specifically is it proposed to add to the sum of knowledge of the subject? Such a contribution may deal with some new point, or those still in doubt, or determine applications to the conditions in the region.
>
> The Procedure. It should be up-to-date, representing the progress and current views on methods and technique. It should give data that will stand statistical analysis and be comparable with other similar accepted data. Does it cover the requirements of the subject, or is it one-sided or inadequate in some respects?
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> Thoroughness. The project should be designed to undertake thoroughly and with reasonable completeness the investigation of the subject and should not be fragmentary and superficial.
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> Probable Duration. Is the time element a reasonable one? Does the project commit the station to a course it may not be desirable to carry through?

> The Funds Required. Is the estimate ample for the proposed investigation? Are the expenses and other essentials within the means of the station budget?"

If these points are kept in mind by the research worker who prepares the project statement, and again by the administrative head of the home economics department who is usually the first person to pass judgment upon the project statement, it is quite likely that the project when it goes through the next stage, approval by the station director who alone controls the distribution of station funds, will receive more generous financial support than would a carelessly written, unconvincing project. And finally when the project reaches the Office of Experiment Stations, there will not be the delay of further correspondence concerning doubtful points that so often holds up a project before final approval can be given.

The Publication of Research.--Quoting Dr. Allen again--

> "The ultimate aim of research is publication. It may be deferred, but it is due eventually if the research has been successful. To some this final task, like the end of a poor cigar, is often very bitter. But in research the end is even more important than the beginning, and quite as deserving of being well done as any other part of the work."

This was the introduction to a lecture on The Publication of Research given before a class in "The Nature and Method of Research" of the Graduate School of the Department of Agriculture. Since this is no longer available it may be well to outline briefly some of the points made. Calling attention to the unfortunate fact that "much scientific writing of the present time is loose and indefinite in its expression, verbose often to the point of being tedious and out of harmony with the ordered, exact, and logical nature of science itself," while the aim in publishing research, as well as in carrying it on, should be "to leave the field clearer than you found it,"

Dr. Allen discussed the obligations of the writer to the reader in the matter of clearness, brevity, and style and with these essentials in mind presented a method of procedure for the preparation of manuscript, discussing in turn the outline, title, introduction, body of article, data and tabular matter, illustrations, and conclusions. The final emphasis was on the necessity and importance of editorial review of the manuscript before it is presented for publication. Quoting freely--

> "Study to communicate the results of research in a way that will involve the least effort on the part of the reader to take them in.
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> "Writing that leaves the reader's mind in such a condition that it can uninterruptedly follow the meaning of the paper without being conscious of the words has been described as good style.
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> "As a rule, the more definitely a fact has been established by an investigation, the more directly and simply it can be presented. It is the doubtful ones that have to be hedged about with explanations, qualifications, and cautions.
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> "The style of the technical paper should be simple, straight forward, and dignified. It should suggest neither a fairy tale, a sensational newspaper story, nor a sermon, but rather a simple, unaffected, and uncolored account of work done and its application.
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> "One of the first requirements is that the paper should be systematic, orderly, and logical in its method of presentation, progressive in its effect, so that the course can be followed and interest will cumulate to the very end.
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> "Of course there is a limit to what can be put into a title, but it should be specific and descriptive as far as it goes.
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> "Next will come the introduction, which, in an account of research, would set forth the problem and give a brief review of the recent literature bearing on the subject.
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> "The reader will naturally be interested in a brief statement of the plan of the procedure, the method employed, an indication of the scope of the study, and conditions under which it was done. The account will aim to show that the writer had a clear purpose in starting the work, realized what he was going after in his investigations, has the facts arranged in his own mind, and has studied them so that he can impart them to others and draw warranted deductions and conclusions.

"The object of a table is to present a picture of the data, as complete in itself as possible. The purpose of tabulated data is not alone to record it, but to clarify the subject--to present the matter more clearly and concisely than it could be presented in the text....Don't forget that the reader will expect the author to make some explanation of what he considers a table shows, or how it prepares for what is to follow.

"The object of illustrations is to illuminate the text but not to embellish it--to make it more intelligible, or to give more definite expression.

"The important points developed in the investigation should be brought together, with such deductions, suggestions, or generalizations as seem warranted. The accurate drawing and stating of these conclusions is one of the most delicate steps in preparing a scientific paper, requiring not only caution and discrimination but unusual care in wording to avoid possible misunderstanding."

No less valuable as a practical guide in the preparation of scientific papers is an editorial in the Journal of Home Economics, based on Miss Atwater's discussion of the subject at the Boston meeting of the research committee of the American Home Economics Association. (9) Included among her suggestions to inexperienced writers is the important one of considering the usage of the journal to which the paper is to be sent as regards such typographical matters as subheads, methods of designating charts and tables, and the form of literature citations. The joint committee on policy and manuscripts of the Journal of Agricultural Research has issued a statement concerning its editorial policy. (10) Other journals regularly carry statements of their policies or, if not, a careful perusal of the papers in any issue will reveal them. Attention to such matters, however irksome, will have its reward in the psychological effect upon those who pass upon papers for publication.

"Professor Atwater's dictum that heaven is a place where you carry on investigations without having to write them up strikes a sympathetic chord in the breast of most scientists. The more one comes to know them and their methods, however, the more one realizes that those whose work ranks high accept the mundane necessity for writing reports and, having accepted it, patiently devote whatever time is needed to the task of making them accurate in fact, orderly in arrangement, and clear in statement." (9)

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